

XIII. — *A Review of South-African Land-Mollusca belonging to the Family Zonitidae.* By Lt.-Colonel H. H. GODWIN-AUSTEN, F.R.S. &c.

[Plates I.-VII.]

Introduction.

FOR some years past Messrs. James Cosmo Melvill and John H. Ponsonby have contributed valuable conchological papers to the 'Annals and Magazine of Natural History' on the South-African Land-Mollusca; their 'Check List of Non-Marine Mollusca' is a record of some 21 families, containing 57 genera and 367 species from that part of the world. Up to the present time our knowledge of the animals of African land-shells is very limited, and when I received from Mr. John Ponsonby, some years ago, several specimens of a species preserved in spirit from Port Elizabeth, examination showed considerable divergency from the Australian genus *Helicarion*, to which it had been assigned, the type of which is *H. cuvieri*, Fér. (*vide* Moll. Ind. vol. i. 1883, p. 146, pl. xli. anatomy of *H. helena*, G.-A.)*, still more did it differ from Indian species which had been placed by various authors in this genus *Helicarion*. Very soon after my first examination of the animal sent to me as *Helicarion hudsonie* it was evident that it had no representatives in the Indian and Malay region, and the genus *Peltatus* was created for it in 1908.

During the last few years, however, valuable material has been collected and sent home by Messrs. M. Connolly, Henry C. Burnup, J. Crawford, J. Farquhar, and others, while Mr. John Ponsonby has twice visited South Africa. In the conchological work, the determination of the species, Messrs. Ponsonby, Connolly, and Burnup have devoted all their knowledge and time, and the two latter gave me many valuable notes on the animals they collected. They have most kindly placed the spirit-specimens in my hands for examination—truly a splendid series of species and varieties from numerous widely separated localities, mostly in a beautiful state of preservation. As this material came

* This species is the same as *hyalina*, Pfr. Mr. Brazier states that the examples obtained by Godwin-Austen were from a colony introduced from Queensland: Proc. Linn. Soc. New South Wales, 31st December, 1890, "On the Naturalized Forms of Land and Freshwater Mollusca of Australia." See form of the animal, Moll. Ind. i. pl. xli., reproduced from an excellent water-colour drawing from life by Mrs. H. Forde (1870).

to hand, it became apparent that we were dealing with forms representing a distinct branch of the great family Zonitidæ—a branch given off from the parent stem in the remote past, and long isolated in Africa from branches in other lands, such as the Ariophantinae and Macrochlamyinae of India.

Following the course of evolution and breaking up into generic divisions, it was interesting to observe how a similar and parallel development of parts had gone on in two widely separated areas. It has been my aim, in this study of comparative anatomy of the African species of Zonitidæ under review, to construct a classification somewhat similar to that of the Asiatic representatives of the family as built up by the labours of Semper, Stoliczka, and others. Occupied with other work, I much regret the delay which has occurred in publishing the results; it must be remembered that the material to examine, though large, was very unevenly distributed among species, some being represented by several specimens, many others (often undetermined) by only one. It is very difficult to secure a satisfactory knowledge of all the internal anatomy with only a single animal to deal with; to wait for more material would perhaps mean years.

With regard to the animal, I cannot say too much as to the importance of making notes and, if possible, drawings of them when freshly taken. Colour is destroyed in spirits, and we want to know to what extent the lobes cover the shell, and in those species where the lobe at the extremity of the foot is much elongated, to what extent, and how it is carried in life. In contracted spirit-specimens (and all the drawings in this paper have been made from them) the true form and size can only be estimated; fortunately, having seen and kept many of the Indian slug-like forms alive, I have been able to form a fair idea of what these African snails are like.

Notice, by collectors in the field, should be taken of the coloration and markings of the animal generally, especially that of the visceral sac when the shell is removed. When I took up the examination of this African group of mollusks my attention was called very early to the great variability displayed in the visceral sac. Beginning with the edge of the mantle, the wall of the branchial cavity and the region of the kidney and heart were often beautifully mottled and streaked in various ways, in one or more colours—in rounded spots or streaks, either fine or coarse; and although not absolutely identical in arrangement in every specimen of the same species, yet on the whole it was a typical distribution of colour. Spotting in some cases would be continuous to the apex, while in other species there was no spotting at all,

and in its place some uniform tint pervaded the whole visceral sac up to its position in the apical portion of the shell.

I was first led to notice specific variation in this part of the animal lying within the shell when going over a large collection of species of *Macrochlamys* from Sikkim. I have laid stress on the character very fully in the descriptions of species in this paper, trusting that it may be useful in their determination, particularly of local varieties.

It is apparent and worthy of notice that these South-African snails, hitherto placed in the genus *Helicarion*, have characters, external as well as internal, not at all like those of typical species of the genus, viz. *H. cuvieri* and *hyalina* of Australia, previously alluded to.

They differ also from species inhabiting India and the Malay Archipelago, Malayana, &c., at one time also placed in *Helicarion*. I have good grounds, therefore, for locating the South-African species in a new subfamily, for which I propose the name *Peltatinæ*, particularly as the species I have now examined from South Africa can be readily separated into several well-defined genera.

Unfortunately I have not that personal knowledge of the physical features and the local distribution of the fauna and flora of South Africa which is so desirable when writing a paper such as this. All I have seen of the country is the immediate neighbourhood of Cape Town and Simon's Bay, for the vast extent beyond that I am indebted to books of travel and meeting those who have been there.

Like Southern India it is a land of great antiquity, a very large portion not having been beneath the ocean since pre-Cretaceous times, during which vast changes in sea and land were going on in other parts of the world. There was a period indefinitely associated with the outburst of volcanic activity in Southern India when the two countries had a land-connection. This renders a study of the molluscan fauna of Africa of such extreme interest. Wm. Blanford, writing so long ago as October 1876, in the pages of this journal (vol. xviii, p. 277), on "The African Element in the Fauna of India," says: "I was especially desirous also of working out the very difficult question of terrestrial Mollusca, the distribution of which, as Mr. Wallace has just pointed out in his 'Geographical Distribution of Animals,' whilst agreeing in some respects with that of the Vertebrata, presents some very singular anomalies." In this family of the Zonitidæ, although we do not find a single genus common to Africa and Southern India, yet there is

this curious similarity. The Peltatinæ in the former country hold the same position the Ariophantinae do in the latter.

The remarkable variation in anatomical detail met with in the species of this subfamily has, I suggest, some relation to the very great extent of country over which they are distributed, and still further to be accounted for by the extremely long isolation each species has probably undergone in its own particular habitat.

The physical nature of the country and the great distances across high, arid, treeless tracts point to this, and isolate more widely than usual the localities from which the animals described in this paper have been received. A glance at the map of South Africa will show this more clearly. Thus from Cape Town north-east to Pretoria is 800 miles, from Cape Town eastward to Port Elizabeth is some 400 miles, and another 425 or so on to Natal with Durban and Maritzburg, while from this last place to Pretoria is over 300 miles. Most of the intermediate country between these localities does not appear to be of a climatic nature conducive to the rapid extension of mollusks of this kind possessing extensible lobes to cover the shell; their habits and requirements necessitate a considerable amount of moisture. They could only unrestrictedly move along the lines of main drainage or the more wooded jungle-clad slopes of the lateral ranges.

Species very similar in shell-characters are found far beyond the area I have above indicated, many of which I have noticed in the Natural History Museum, but as the animals of these species are not yet known they can only be placed provisionally in the Peltatinæ.

Further north, in Africa and in Abyssinia, we know that *Helicarion*-like shells of the family Zonitidæ occur, represented by the genus *Africarion*, type *palleus* or *lymphaceus*, Morelet, described by me in the 'Mollusca of India,' vol. i. pp. 154-158, pl. xlii. As we obtain further malacological knowledge of these species, their true geographical distribution and limits of range and their relationship will be of extreme interest.

Even while preparing this paper, my attention has been called to a very excellent, valuable contribution to our knowledge of African land-shells by Professor Dr. J. Thiele, entitled 'Mollusken der Deutschen Zentralafrika-Expedition,' 1907-1908. This expedition, under the leadership of Adolf F. Herzog zu Mecklenburg, has been productive of good work, and Professor Thiele describes a large number of new species in many genera. Some eight species are re-

ferred to *Helicarion*, three to *Vitrina*. The value of the paper is much increased by the figures of the generative organs given on plate vi. Among these it is interesting to note how similar in every way are these organs in no. 60. *H. kivuensis*, Thiele, no. 63. *H. schubotzi*, Thiele, and no. 59. *H. semi-membranaceus*, v. Martens, to the species of South Africa which I place in the Peltatinæ, particularly in the first two species. In no. 60, *kivuensis*, what is marked (*d*) is evidently the flagellum coiled up with the accessory gland as seen in *phadimus*, M. & P., and will be figured in the next part of this paper, while the form of the spermatheca is precisely the same. In no. 63, *H. schubotzi*, the penis is separated out and all its parts are distinctly displayed, the flagellum given off close to the vas deferens, the accessory gland on the epiphallus, peculiarly long in this species.

A glance at this plate shows some other very distinct groups to exist in Africa. In fig. 69, *Helicarion auriformis*, Thiele, can, I suggest, be placed in *Africarion*, while no. 58, *H. plicatulus*, v. Martens, evidently waits to be placed in a new African genus yet to be described, one possessing an amatorial organ. Here is work which I trust Professor Thiele will take up; he may perhaps have already done so. I must not intrude into the sphere of his labours.

As this paper will extend into, perhaps, two more parts of this journal, it becomes necessary to give with the first contribution a list of the species and the genera in which I provisionally place them. A key to the species of the subfamily I propose giving with the final portion, by which time I trust I shall be in possession of further material and be able to know more of species I have not attempted to name up to the present.

Description of the Subfamily Peltatinæ.

Shells globose or globosely conoid, rather thin, some transparent, of few whorls.

Animal.—Foot divided and with the usual peripodial grooves. Mucous pore at extremity of foot, with a lobe above it; in some species this becomes much lengthened and horn-like. Both right and left shell-lobes present, either small or much lengthened or expanded to cover the shell. The generative organs present a male organ with a long flagellum and a free cæcum coiled up together, the cæcum contiguous to but distinct from the retractor muscle. Spermatheca a large bag on a strong stalk. The spermatophore elongate, of elaborate form, with many branched spines, varying in their shape in different species.

Radula and jaw as in the family.

South Africa, ranging northward; limits as yet unknown.

Compare description of *Ariophantina*, Faun. Brit. Ind., Moll. p. 25.

Description of the Genus Peltatus.

Shell with decussate or punctate sculpture adjacent to the protoconch, but not extending to the surface of the last whorls.

Animal with short lobe over the mucous gland at end of the foot and with short shell-lobes; in one or two species both are more elongate, in two there is a sharp bend in the penis-sheath.

The South-African species of *Zonitidæ* which I have now seen appear to range themselves as follows:—

Species of *PELTATUS*.

Shells with decussate or punctate sculpture adjacent to the protoconch.

<i>aloicola</i> , M. & P., type.	Port Elizabeth.
—, var.	Grahamstown.
<i>trotteriana</i> , Bs.	Cape Colony.
<i>caledonensis</i> , sp. n.	" "
<i>capsula</i> , Bs.	" "
<i>natalensis</i> , Pfr.	Port Elizabeth.
<i>cotyledonis</i> , Bs.	Cape Colony.
<i>hudsonicæ</i> , Bs.	" "
<i>arnotti</i> , Bs.	" "
<i>phytostylus</i> , Bs.	" "
<i>asthenes</i> , M. & P.	" "

Of the last four the animals have yet to be examined; the shell of *phytostylus* has a peculiar columellar margin, it will be interesting to see how far the animal differs from the species with which it is now included.

Species of *KERKOPHORUS*.

Sculpture the same throughout, apex smooth, some species polished and shiny. Animal with very long lobe at extremity of foot. Right shell-lobe large and broad, left also large.

<i>inunctus</i> , M. & P., type.	Alexandra Junction, Maritzburg.
<i>vitalis</i> , M. & P.	Port Shepstone.
<i>leucospira</i> , Pfr.	Tangaat.
<i>phædimus</i> , M. & P.	Maritzburg.
<i>melvilli</i> , sp. n.	Equeefa.
<i>corneus</i> , Pfr.	Maritzburg.

Shell-lobes lengthened and narrow.

<i>natalensis</i> , Krauss.	Port Elizabeth.
<i>ampliatus</i> , M. & P.	Maritzburg.
<i>poepfigi</i> , Mke.	Alexandra Junction, Maritzburg.

No. 15, sp. n. ?	Maritzburg.
Nos. 12 and 13, sp. n. ?	Equeefa, East London.
<i>cingulatus</i> .	Port Elizabeth.
<i>fuscicolor</i> , M. & P.	Harris Smith.

This last appears to be a connecting-link with the next new genus.

New genus MICROKERKUS.

Lobe over mucous gland shorter ; shell-lobes much reduced in size.

<i>symmetricus</i> , Craven.	Pretoria.
<i>poudoensis</i> , sp. n.	Pondoland.
No. 72, sp. n. ?	Thabanchu, O.R.C.

New genus ?

<i>transvaalensis</i> , Craven.	Game Pass, Mooi River.
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New genus ?

<i>pumilio</i> , M. & P.	Transvaal.
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In the 'Annals and Magazine of Natural History,' February 1908, p. 131, I gave a description of a South-African land-shell which was then considered to be the same as *Helix* or *Helicarion hudsonie* of Benson, from three very badly preserved animals from Port Elizabeth. Sufficient was then seen of the external form and of the anatomy on which to create a new genus, *Peltatus*. The type shells are in Mr. John Ponsonby's collection.

I have now received and examined some animals of a species from another locality, some 60 miles to the eastward and inland, Grahamstown, also labelled *H. hudsonie*, collected by Mr. J. Farquhar, a resident. They are beautifully preserved, so I am able to extend and much correct errors in the original description.

The drawing of the generative organs (Pl. IV. fig. 1*b*) is far more correct than figs. 1*a* and 1*b* on pl. viii., 1908, made from specimens in a very decomposed state, and it serves to show the blunders one may fall into when working and drawing conclusions from inferior material. What was then assumed to be the retractor muscle of the male organ (*r.m.p.*), shown in dotted lines, is the free caecum (*c.r.p.*), and should come out, the retractor of the penis was really lost. The spermatophore is in its right position in process of forming, and the spermatheca is correct ; of an ovoviviparous habit I was led to suppose there was not a sign. The vas deferens in fig. 1*a* does not join where indicated, and this and the oviduct (*ov.*) are all drawn out, and out of place owing to the soft state of the specimen.

Comparing the shells of these animals from Port Elizabeth and Grahamstown, they do not agree with the typical

examples of *H. hudsoniæ*, to which both have been assigned, nor are they quite similar to one another, though so exceedingly close; I should be sorry to separate them. *Helix hudsoniæ* having been referred to as the type of *Peltatus*, it becomes necessary to begin with the shells of that species originally collected by Benson, about 300 miles away to the westward, and refer to his description.

Helix hudsoniæ, Bs.

Ann. & Mag. Nat. Hist. ser. 3, vol. xiii. p. 403 (1864).

Original description :—

“*H. testa minutissime obtecte perforata*, globoso-depressa, tenuissima, lævigata, striatula, lineis minutissimis confertissimis spiralibus superne decussata, prope umbilicum polita, cornea, translucente, prope suturam linea angusta rufescente ornata; spira depresso-conoidea, sutura submarginata, apice obtuso; anfractibus $3\frac{1}{2}$, rapide acrescentibus, convexiusculis, ultimo lato, ad peripheriam rotundato, subtus convexo: apertura obliqua, globoso-lunata, marginibus subconniventibus; peristomate tenui, acuto; margine collumellari superne breviter reflexo, perforationem obtegente.

“Diam. major $12\frac{1}{2}$, minor $10\frac{1}{2}$, axis 7 mm.

“A single full-grown specimen, with the young, was received from Mrs. J. F. Hudson, with *H. phytostylus**. The shell has a Vitrinoid appearance; but the sculpture, perforation, and suture, as well as the character of a portion of the animal remaining in the shell, prove it to be a *Helix*.”

Examining the sculpture of specimen dissected (no. 2022) from Grahamstown, and observed under high power, the protoconch appears to be quite smooth; it soon passes to a very beautiful and finely decussate surface, in parts punctate up to the second whorl, where it merges into very microscopic longitudinal striation.

Three specimens of *H. hudsoniæ* are in the Natural History Museum, presented by Mr. R. McAndrew in 1873; they are, I am inclined to think, the type shells from which Benson made his description, and alluded to as one full-grown specimen and one young, because the coloured suture he mentions is very conspicuous, most probably due to some colouring-matter derived from the soil and not a true character. In these type shells it was interesting to find in the apical part of the shell the decussate surface mentioned above in the Grahamstown shell.

* Colesberg, 235 miles west of Natal, and near Riversdale, Swellendam, about 100 miles east of Cape Town.

I also compared the six specimens of this species in the McAndrew collection, Cambridge, kindly sent to me by Mr. L. Doncaster, to whom my best thanks are due. Four of these show ruddiness in the suture. The perforation is exceedingly minute, as Benson describes. Looking at the so-called *hudsonie* sent me by Ponsonby and Burnup from Port Elizabeth and Grahamstown, perforation is not apparent; the shells, too, are darker and far more solid in structure than the typical form. I am therefore disposed to consider that true *H. hudsonie* is confined to the area around Swellendam. The four specimens under this name in the Natural History Museum collection from Algoa Bay show minute perforation, but differ from the typical shells in being larger, $13\frac{1}{2}$ mm. in major diameter.

Only a comparison of the animals of *hudsonie* from the original habitat, with those I have mentioned from the country further east, can conclusively solve what degree of difference there may be in the animals; judging from those I have dissected from the western side, it will not be very great.

Peltatus aloicola, M. & P., var. (Pl. IV. figs. 1. 1 a, 1 b.)

Locality. Grahamstown (*J. Farquhar*).

The animal: the foot is indistinctly divided.

The lobe over the mucous gland is quite small (Pl. IV. fig. 1 a).

Both right and left shell-lobes are small and narrow (Pl. IV. figs. 1 & 1 a).

The visceral sac is much mottled with a ground-colour of pale ochraceous, but milky white is the predominant colour. There is a narrow border of black on the mantle-edge in front: the branchial sac up to the kidney (*k*) is broadly streaked with white; this organ is bordered by a narrow bar of black, sharply edged with white, thence to the apex there are large blotchings of white with a few small spots of same colour mixed with them. I have examined some eight specimens; the bar of black is a conspicuous feature, showing through the shell.

Generative organs (Pl. IV. fig. 1 b).—The penis-sheath is doubled on itself in close S-form, the retractor muscle is given off just above it; the epiphallus is fairly long, with a short caecum-like accessory gland about midway. Flagellum short and pointed. Spermatheca globose on a thick stalk.

Radula formula: 46 . 2 . 14 . 1 . 14 . 2 . 46. or 62 . 1 . 62.

Jaw with a central projection.

The shell of *aloicola*, var., under high powers, is smooth on the last whorls, with the faintest indication of irregular striæ lines running longitudinally; near the protoconch the surface is decussate or punctate.

Recently (November 1911) I have seen quite a number of shells of this species from the Ponsonby collection, fine specimens and fully grown, whereas those sent me, preserved in spirit, were quite young shells—the major diameters respectively being 11.5 and 16 mm. As is, I fear, generally the case, the finest shells find their way into the cabinet, the finest animals are thrown away, at one time they were never saved at all.

From Port Elizabeth has been described as a var. of *hudsonia* another species, *aloicola*, M. & P. I have compared the type shells of this with *hudsonia*, Bz., type of *Peltatus*, originally described in 1908, and I cannot see any difference to seize on. Fortunately one contained a dried-up animal, and this clears the position up, for after a lengthy soaking I am able to give the following description:—

Peltatus aloicolor, M. & P.

Port Elizabeth.

Animal.—Visceral sac, ground-colour dark brown, with a very large amount of white, broadly distributed, and extending to the apex with a few white spots: *vide* description of the Grahamstown species. The right shell-lobe and the extremity of the foot had been unfortunately destroyed, but the left shell-lobe was intact, small, and triangular, somewhat similar to fig. 1 a, Pl. IV.; I therefore infer the right shell-lobe is small, as in fig. 1 a of the same Plate. There is a sharp bend in the shaft of the male organ, and the generative organs correspond to those of that Grahamstown species: a well-developed spermatophore is also present. The two specimens are very much alike and may both be taken as typical of the genus *Peltatus*. More observations of both in a living state would be conclusive and are required. The radula was extracted complete; it has a great number of teeth in the row, the marginals becoming very minute and evenly bicuspid. I counted the row to be 90 . 3 . 13 . 1 . 13 . 3 . 90, or 106 . 1 . 106. Jaw with no central projection as in pl. viii. fig. 1 c, Ann. & Mag. Nat. Hist. ser. 8, vol. i.

With regard to the sharp S-like bend in the shaft of the male organ which occurs in *P. aloicola*, var. (Pl. IV. fig. 1 b), *caledonensis* (Pl. V. figs. 1, 1 a, B), and *trotteriana* (Pl. VI. fig. 1 c), this is met with in other species, varying in

degree, and is indicated in a different way or absent as in *natalensis* (Pl. VI. fig. 2) and in a yet unnamed species no. 15 to be described later on.

For some time I was at a loss to account for the presence and meaning of certain very defined lines on the surface of the main shaft of the penis when making drawings of the genitalia: see *symmetricus* and *melvilli*, figured in the next part. It would appear that this folding becomes so buried in the muscular tissue which holds the folds together, as a last phase, that it is concealed altogether. In the other direction the folding is so slight that only an indication of it remains, as in no. 15; in *capsula* and nos. 12 and 13 (also undescribed species) it is altogether absent.

Peltatus caledonensis, sp. n. (Pl. II. figs. 1, 1 a.)

Locality. Houn Hoek, Caledon Div., Cape Colony (Connolly).

Shell conoid, no perforation; sculpture decussate near apex, rest beautifully fine and regular, microscopical longitudinal striation, crossed by the lines of growth; colour dull ochraceous or straw; spire subconoid; suture impressed; whorls $4\frac{1}{2}$; aperture oblique, rotundate, curve near circular on the thin peristome; columellar margin vertical, not thickened.

Size: major diameter 12·75, minor 11·0; alt. axis 6 mm.

This shell is remarkably like that of *capsula*, Bs., from Simonstown in the sculpture, but is much higher in the spire, also very close in form to typical *hudsoniae*, Bs.

Connolly, writing to Mr. J. Ponsonby, says: "No. 60, *Peltatus* sp. 2 in spirit: these will, I hope, be of interest, for Colonel Godwin-Austen will at once settle whether they are *Peltatus* or *Helicarion*, and whether or not they are the same as the shell from Simonstown, one of those already in your hands unnamed [*capsula*, Bs.], and also whether both the Houn Hoek and Simonstown shells = *Peltatus hudsoniae*, as Burnup thinks probable."

Animal.—Extremity of the foot truncate (Pl. V. fig. 1 e), the lobe above elongated. Foot divided. Right shell-lobe long and narrow (Pl. II. fig. 1 a), much longer than in what has been called *P. hudsoniae*, var. = *alvicola*, var., from Grahamstown. The left shell-lobe is triangular and small (Pl. II. fig. 1). Visceral sac (same figure) is closely mottled black, and forming thus two parallel bands, the lower the most distinct near the kidney, the upper one arranged in zigzags. The apical whorls black, with large white spots.

There is here a similarity with the species from Simonstown identified as *capsula*, Bs., but they are not the same. The animal compared also side by side with *aloicola*, var., is at once seen to be different in the distribution of colour and consequently of pattern.

In the generative organs (Pl. V. figs. 1, 1 a) the penis is closely bent on itself in S-shape (B) and held together by muscular tissue; close above this bend the retractor muscle is given off, and then comes a short straight accessory gland or cæcum on the epiphallus, which is not very long, to where the vas deferens joins; here is a fairly long flagellum. The spermatheca is a large globular sac on the head of a strong and lengthened duct. There is remarkable similarity here with the generative organs of *aloicola*, var., of Grahamstown, and this extends to the spermatophore. I was not fortunate enough to find this in a perfect state, but enough pieces were found in the spermatheca to show the form of the spines. They were found to be different from those of species hitherto examined from S. Africa. They are beautifully branched, and each branch terminates in a peculiar flat bifid end (Pl. IV. fig. 3). It is interesting to note that in *aloicola*, var., similar pointed spines occur; the contents of the spermatheca in three specimens were examined, and in one two or three such points were discovered, all the rest had been absorbed. The jaw (Pl. V. fig. 1 b) has a central projection on a concave edge. The radula (Pl. V. fig. 1 c) formula is $58 \cdot 2 \cdot 9 \cdot 1 \cdot 9 \cdot 2 \cdot 58$, or $69 \cdot 1 \cdot 69$. The admedian are all bicuspid, nearly equally so, becoming more even as they approach the margin. The last three on the edge are very small (Pl. V. fig. 1 d) and three- to four-cuspid.

This is a true *Peltatus*, its anatomy as regards the genitalia being similar in every respect to the typical species. It differs, however, in the shell-sculpture and in the radula and general colour of the animal.

Peltatus capsula, Bs.

Ann. & Mag. Nat. Hist. ser. 3, vol. xiii. p. 492 (1864).

Locality. Simonstown.

Captain Connolly writes, under date 12th January, 1910:—"With no. 31, ?*Helicarion*? n. sp., loc. Simonstown, probably a *Peltatus*, and Burnup thinks it may be merely a var. of *hudsonice*. The live animal is palish grey, with a beautifully spotted mantle and long wavy horn on its tail." The shell is not at all like *P. hudsonice*, of which the type has been preserved both in the B. M. and Cambridge

Museum. The apical whorls are sculptured with fine regular longitudinal striation, which merges into finer striation on the rest of the shell.

The animal in spirit is very pale in coloration, with the overhanging long lobe on the extremity of the foot tipped black. Both the right and left shell-lobes are long and narrow. Foot long, narrow, and divided.

The wall of the branchial sac is, as Connolly describes it, beautifully streaked and mottled with black and pure milky white, the dark spots larger over the kidney and heart. Towards the apex the sutural line is bordered black, with a few white spots.

The generative organs (Pl. VII. fig. 2) are in every respect like those of *Peltatus*, with the exception of the sheath of the penis being straight, not S-shape; there is a vestibule; the accessory gland is short and thick, the flagellum the same. The spermatheca on a thick stalk, the sac much enlarged and elongately pear-shaped. This sac contained a spermatophore (Pl. VII. figs. 2a, 2b) in a most perfect stage of development. On the flume of this are some twenty-five many-branched spines closely set together on one side only; although in fig. 2a they appear alternately on either side, it is a twisting of the flume which gives this appearance. The branches do not terminate in the bifid manner as is usually the case, but splay out and become flat-topped.

Peltatus cotyledonis, Bz.

Locality. Koumetje, south of Cape Colony (*M. Connolly*).

Shell strongly decussate next protoconch when examined under high power.

Animal with foot dark-coloured below, pale above, with lobe over mucous gland. A tongue-shaped right shell-lobe, dark tipped and finely pointed, and a small left shell-lobe given off from a broad base; left dorsal lobe divided into two narrow parts. The anterior part of the visceral sac plain, towards the apex dark, white at apex.

The radula formula is 50 . 3 . 9 . 1 . 9 . 3 . 50, or 62 . 1 . 62. Form of the teeth as in all this genus—the marginals bicuspid, inner cusp slightly the longest, the outermost teeth more evenly bicuspid. Jaw with a central projection.

Captain Connolly tells me “the live animal is of a peculiarly orange-brown colour, almost pure orange, especially the under part.” Ponsonby gives me this extract from Connolly:—“I am pretty certain that *Zingis ajra* and *pinguis* do not have horns on their tails, while *thermarum* and *cotyledonis* do.”

It was unfortunate to find the spirit all evaporated in this tube, so that the animals were dried up and the genitalia could not be made out after the soaking it was subjected to; but enough was seen to place it in its generic position.

Peltatus trotteriana, Bs. (Pl. V. figs. 2, 2 a.)

Locality not given on tube.

First specimen dissected: animal brown, as also the ground-colour of the visceral sac, but very little of the ground-colour is to be seen; the greater part of the surface on the upper side is covered with large isolated patches of milky white, while on the lower side the same colour occurs as small spotting. A black band margins the liver, another, less distinct, the rectum.

The right shell-lobe is short and triangular, the left shell-lobe is very small. The lobe above the mucous pore is fairly large (Pl. V. fig. 2 a).

Tecti of the radula are similar to those of *Microkerkus pondoensis*; marginals evenly bicuspid.

Radula formula: 65 . 2 . 11 . 1 . 11 . 2 . 65, or 78 . 1 . 78.

Jaw (Pl. V. fig. 2) with central projection.

Peltatus trotteriana, Bs. (Pl. VI. figs. 1-1 c.)

Locality. Cape Province (*Capt. M. Connolly*); two specimens, no. 78.

Shell globosely conoid, imperforate; sculpture smooth, crossed by a few lines of growth, shows indistinct decussation near protoconch, which is smooth; colour pale ochraceous, more intense at the apex; spire high, conical, apex blunt and rounded; suture well impressed; whorls 4, rapidly increasing, the last very ample, very convex; aperture lunate, higher than breadth, subvertical; columellar margin weak, not reflected.

Size: major diameter 13.5, minor 12.25; alt. axis 8.5 mm.

Animal (Pl. VI. fig. 1, 1 a).—Visceral sac plain, no spotting; a band of pale brown over kidney, in one specimen another much paler next the rectum at the apex dark brown, with some milky white extending over half the upper surface. The right shell-lobe (Pl. VI. fig. 1) very small, the left (fig. 1 a) quite minute, just a remnant. Foot short, very distinctly divided, lobe over the mucous gland very small.

The genitalia (Pl. VI. figs. 1 b, 1 c) were not at the fullest stage of maturity, yet sufficiently so to show all important parts and that they are of the type of the subfamily. The penis just below the retractor muscle is closely folded into

S-shape (*b*); the epiphallus is long, and about midway is a short cæcum. At the junction of the vas deferens there is a rather short thick flagellum, which contained an immature spermatophore. The spermatheca is globose on a thin stalk.

Radula formula: 58 . 2 . 12 . 1 . 12 . 2 . 58, or 72 . 1 . 72.

Helix natalensis, Pfr.

Symbolæ, 1846, iii. p. 65.

Original description :—

“*T. imperforata*, subglobosa, tenuis, lævigata, subdiaphana, corneo-albida, lineis fuscis irregulariter radiata, *spira elevatiuscula*, obtusa; anfr. 4, vix convexiusculi, ultimus inflatus; columella subverticalis, filiformis, profunde intrans; apertura lunato-rotundata, intus fulva, nitida, perist. simplex, acutum.

“Diam. 12, alt. 9 mill.

“Port Natal (*Menke*).

“This species is figured by Küster (*Neues Conchyl.-Cabinet*, t. xxix. figs. 30, 32).”

In the Nat. Hist. Museum are four specimens under this name (precise locality not given, only S. Africa), presented by J. H. Ponsonby in 1888. There is this note in pencil: “Compared by Dohrn with Pfeiffer’s type.” The largest measures 15 mm. in major diameter, alt. axis $8\frac{1}{2}$. It shows narrow transverse bands of colour alternating pale and dark. The apical whorls are strongly decussate under high power. Its form is well represented in Küster’s figures, and the striping even indicated.

Peltatus natalensis, Pfr. (Pl. III. figs. 2, 2 *a* ;
Pl. VI. fig. 2.)

Locality. Port Elizabeth.

The animal (Pl. III. figs. 2, 2 *a*) is pale-coloured. The foot has a small overhanging lobe above the mucous pore, no doubt elevated when alive; the oblique grooves on the side of the foot running from the peripodial grooves to the dorsal line of the foot are close together, the margin is rather broad. The right shell-lobe (Pl. III. fig. 2) is long and narrow on the side of the right dorsal lobe. The left shell-lobe (Pl. III. fig. 2 *a*) is also narrow, but very short. The left dorsal lobe is in two parts, the posterior being long and narrow. The visceral sac next the mantle-margin is closely speckled with pure white, and the same colour predominates along the line of the rectum up to the kidney and, with more or less mottling, continues to the very apex. At the generative aperture (Pl. VI. fig. 2) there is an ample bulbous vestibule,

which, on being opened to view, did not show inside the folded walls as in *Kerkophorus inunctus*, M. & P., but the sac contained a good deal of extraneous loose matter, which under a high power had all the appearance of being the broken-down walls of the vestibule, the result of decomposition, the specimen not being in the best state of preservation.

The male organ has a short flagellum, a cæcum, and an accessory gland near the retractor muscle, which is long. The spermatheca is a globose sac on a thick stalk-like duct.

In a row of the radula the teeth are arranged as follows:—

$$56 \cdot 1 \cdot 10 \cdot 1 \cdot 10 \cdot 1 \cdot 56 = 67 \cdot 1 \cdot 67.$$

The central and admedian as in *aloicola*, M. & P., var., and other Cape species. The transition tooth similar, but on a narrower basal plate; it is succeeded by some three teeth, the outer cusp of which is below the terminal point, all the succeeding laterals being unevenly bicuspid and diminishing gradually to the margin, where they become very minute.

Peltatus phytostylus, Bs.

Ann. & Mag. Nat. Hist. ser. 3, vol. xiii. p. 492 (1864).

Original locality. Colesberg.

Peltatus arnotti, Bs.

Ann. & Mag. Nat. Hist. ser. 3, vol. xiii. p. 491 (1864).

Original locality. Colesberg.

The animals of these last two species have not yet been seen by me.

EXPLANATION OF THE PLATES.

PLATE I.

Kerkophorus corneus?, Pfr. Maritzburg.

Fig. 1. Animal, viewed from the right side. $\times 1\cdot5$.

Fig. 1 a. Ditto, left side. $\times 1\cdot5$.

Fig. 1 b. The visceral sac, showing left shell-lobe, the region of the branchial sac, kidney, &c. $\times 4\cdot5$.

Microkerkus symmetricus, Craven. Pretoria.

Fig. 2. Animal, viewed from the right side. $\times 1\cdot5$.

Fig. 2 a. Ditto, left side. $\times 1\cdot5$.

PLATE II.

Peltatus caledonensis, sp. n. Cape Colony.

Fig. 1. Animal, anterior part viewed from the left side, to show the

mantle-edge and small left shell-lobe, with the visceral sac; shell removed. $\times 4\cdot5$.

Fig. 1 a. Animal, viewed from the right side, showing right shell-lobe and right dorsal lobe, and spotting on the visceral sac. $\times 4\cdot5$.

No. 15. *Kerkophorus*, sp. n.?, undetermined. Maritzburg.

Fig. 2. Animal, shell removed, viewed from the right side, shell- and dorsal lobes and visceral sac. $\times 4\cdot5$.

Fig. 2 a. Ditto, from the left side. $\times 4\cdot5$. Equeefa.

Fig. 2 b. The extremity of the foot. $\times 4\cdot5$.

No. 3379. *Kerkophorus*, sp. n.?, undetermined. Pinetown.

Fig. 3. Animal, viewed from the right side. $\times 1\cdot5$.

Fig. 3 a. Anterior part of animal, viewed from the left side. $\times 4\cdot5$.

PLATE III.

Kerkophorus inunctus, M. & P. Alexandra Park, Natal.

Fig. 1. Animal, as seen from the right side. $\times 1\cdot5$.

Fig. 1 a. Ditto, anterior part from the left side, showing the left dorsal and left shell-lobe. $\times 1\cdot5$.

Peltatus natalensis, Pfr. Port Elizabeth.

Fig. 2. Animal, as seen from the right side. $\times 1\cdot5$.

Fig. 2 a. Ditto, left side. $\times 1\cdot5$.

Fig. 3. Extremity of foot of *Kerkophorus vitalis*, M. & P. $\times 4\cdot5$. Natal.

Fig. 4. Ditto of *Microkerkus symmetricus*, Craven. $\times 8$. Pretoria.

PLATE IV.

Peltatus aloicola, M. & P., var. Grahamstown.

Fig. 1. Part of the animal, seen from the right side. $\times 4\cdot5$.

Fig. 1 a. Ditto, from the left side, to show the right and left shell-lobes. $\times 4\cdot5$.

Fig. 1 b. The generative organs. $\times 8$.

Microkerkus pondoensis, sp. n. Kentani, near Pondoland.

Fig. 2. The generative organs. $\times 8$.

Fig. 2 a. Teeth of the radula at different parts of the row. $\times 368$.

Peltatus caledonensis, sp. n. Cape Colony.

Fig. 3. A portion of the spermatophore. $\times 30$.

PLATE V.

Peltatus caledonensis, sp. n. Cape Colony.

Fig. 1. Part of the generative organs. $\times 4\cdot5$.

Fig. 1 a. Ditto of another specimen, more perfect. $\times 4\cdot5$.

Fig. 1 b. Jaw. $\times 12$.

Fig. 1 c. Teeth of the radula, nos. 6 to 16. $\times 368$.

Fig. 1 d. Outermost teeth. $\times 368$.

Fig. 1 e. Extremity of the foot. $\times 4\cdot5$.

Peltatus trotteriana, Bs. Cape Province.

Fig. 2. Jaw. $\times 12$.

Fig. 2 a. Extremity of the foot. $\times 4\cdot5$.

Kerkophorus phœdimus, M. & P. Maritzburg.

Fig. 3. Part of the generative organs. $\times 8$.

PLATE VI.

Peltatus trotteriana, Bs.

Fig. 1. Animal with shell removed, seen from the right side. $\times 4\cdot5$.

Fig. 1 a. The same, from left side. $\times 4\cdot5$.

Fig. 1 b. Portion of the generative organs. $\times 4\cdot5$.

Fig. 1 c. The male organ. $\times 8$.

Peltatus natalensis, Pfr. Port Elizabeth.

Fig. 2. The generative organs. $\times 4\cdot5$.

PLATE VII.

Kerkophorus melvilli, sp. n. Equeefa.

Fig. 1. Portion of a spermatophore. $\times 12$.

Fig. 1 a. Three central teeth of the radula. $\times 368$.

Fig. 1 b. Nos. 12 to 15, transition teeth. $\times 368$.

Fig. 1 c. Lateral teeth about 32 from the extreme margin.

Fig. 1 d. 8 teeth nearer the margin.

Peltatus capsula, Bs. Simonstown.

Fig. 2. Generative organs. $\times 4\cdot5$.

Fig. 2 a. A spermatophore complete. $\times 18$.

Fig. 2 b. A portion of same, A-B. $\times 24$.

XIV.—*Descriptions and Records of Bees.*—XLI.

By T. D. A. COCKERELL, University of Colorado.

Trigona cassiæ, Cockerell.

Additional workers collected by Mr. Turner at Mackay, Queensland, show that usually the scutellum has a broad interrupted cream-coloured band and a spot of the same colour on each axilla. The scutellar band may be only notched, not interrupted, and the axillar spots may be very minute. The new specimens are from flowers of *Cassia*, except one from *Eucalyptus*.

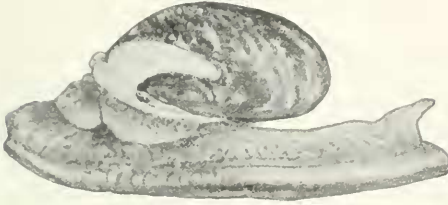
Trigona carbonaria, Smith.

When describing *T. cassiæ*, I suggested that it was perhaps the species recorded by Friese from Mackay as *T. car-*

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1 a



1 b



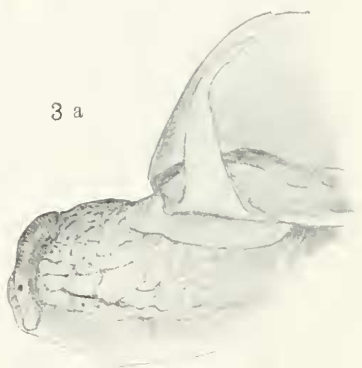
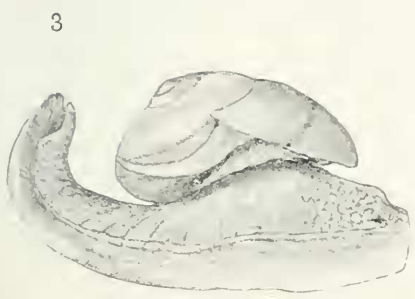
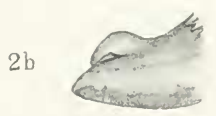
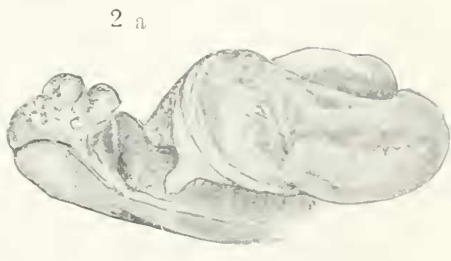
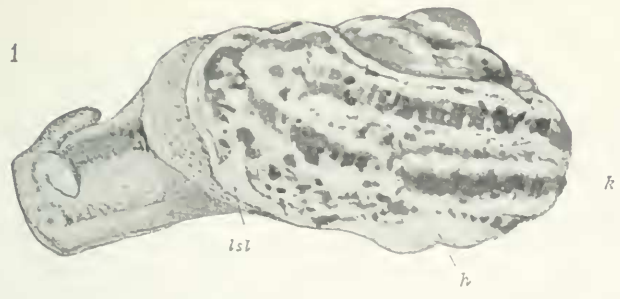
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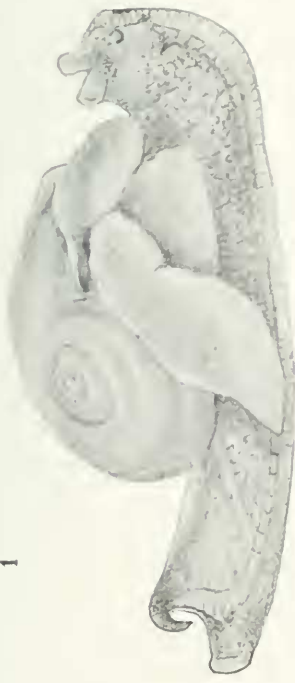


2 a





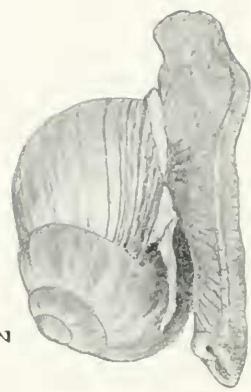
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1a



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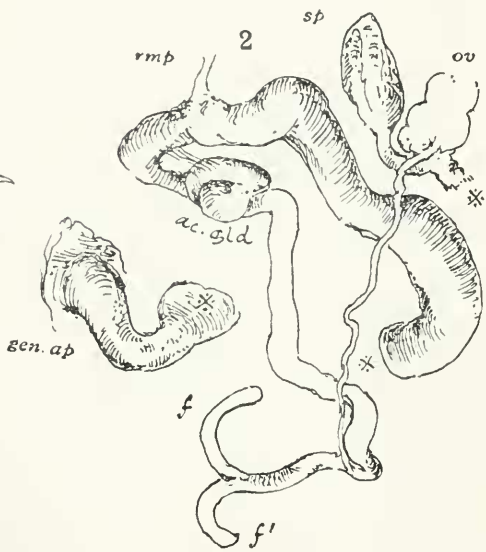
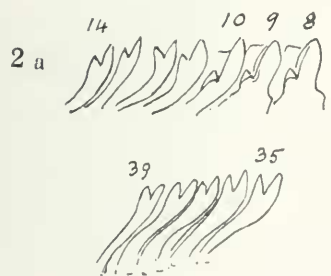
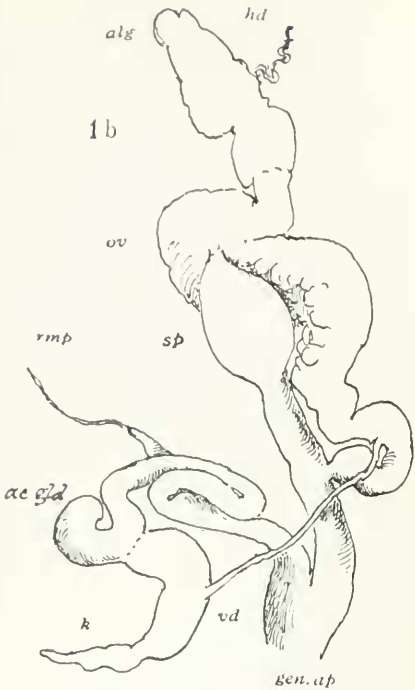


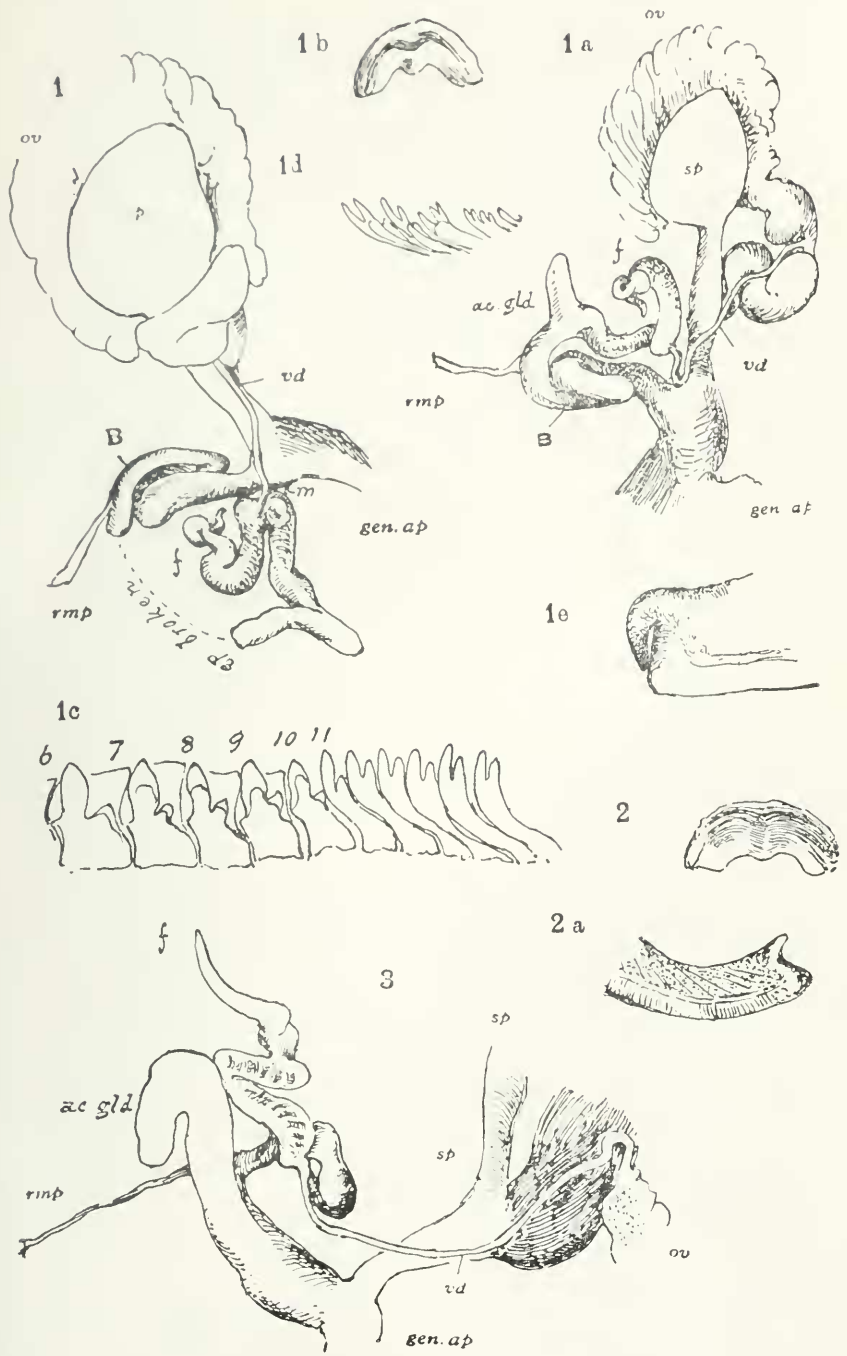
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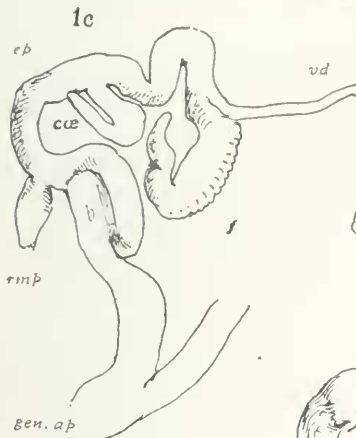
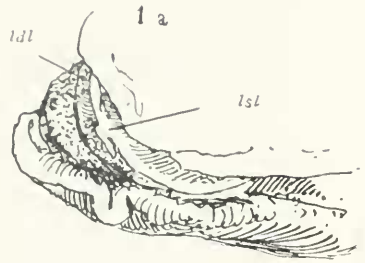


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